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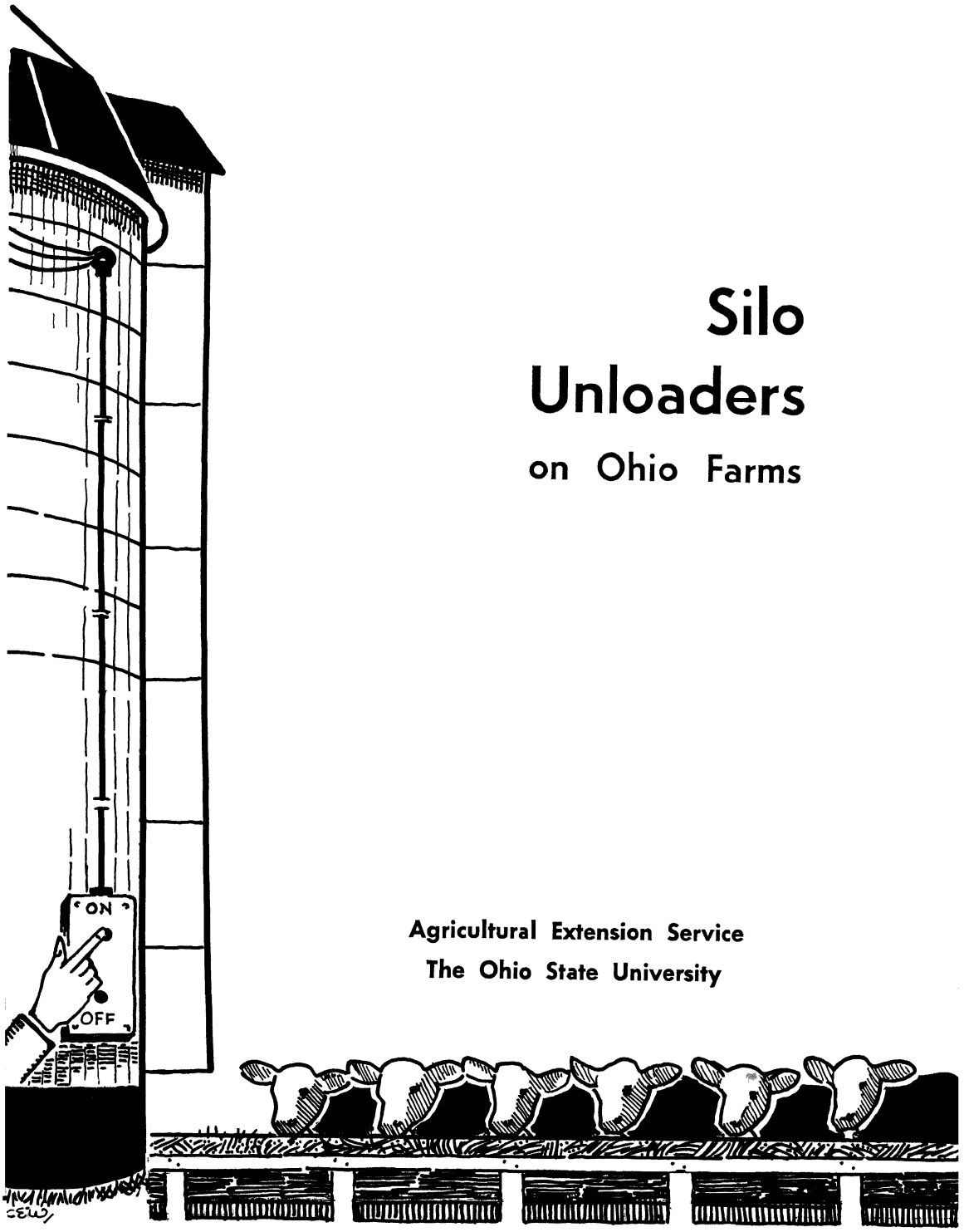
Bulletin 360



Silo Unloaders on Ohio Farms

Agricultural Extension Service
The Ohio State University

A Progress Report

This study of "Automatic Silo Unloaders" was made to obtain information on the merits of the equipment, as it is being used today on Ohio farms. It should be considered a progress report because of the modifications continually taking place on all such choring equipment.

We of the Agricultural Engineering Department believe it desirable to present such information to the public as it becomes available. We also desire to be informed as to farmers' reactions to such mechanical choring equipment. Please send your comments to:

D. M. Byg
Agricultural Engineering Department
Ives Hall, The Ohio State University
Columbus 10, Ohio

Rodger Asmus, a graduate student in the Agricultural Engineering Department, conducted this study as a part of his work on a fellowship sponsored by the Ohio Farm Electrification Council. Appreciation is extended to Department staff members, electric power suppliers, and farmers for their assistance with the project.

Silo Unloaders on Ohio Farms

By Rodger W. Asmus

During the past 5 years many Ohio farmers have installed commercially produced silo unloaders. Now, other farm operators, in their search for means of chore simplification and increased efficiency, are asking, "Do these unloaders reduce manual labor and complete the feeding operation faster? And, what are the costs?"

In 1956, a study was made on various farms in central Ohio to evaluate the usefulness of these machines. Data was collected by survey, by actual performance checks on 24 unloaders of 5 different makes and by questionnaires which were returned by 70 farmers from 24 counties.

Owners reported liking their unloaders, primarily because they saved labor and because the silage from them was well mixed and free from lumps or frozen pieces. Over 80 per cent of the owners reporting, indicated that they would buy an unloader again if they had the chance. Many satisfied users indicated a number of dislikes, but few were dissatisfied for the same reasons.

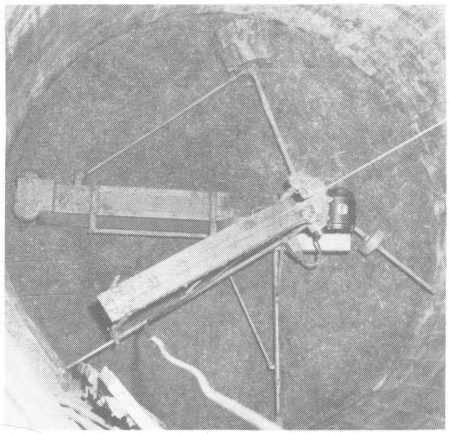
Two Types Studied

The two general types of unloaders available for upright silos were considered in this study. One type was the surface unloader which was suspended by cables from the top of the silo and was gradually lowered into the silage as unloading took place. The other type remained fixed in the bottom of the silo. As unloading progressed, the entire mass of silage was continually settling.

All four makes of surface unloaders tested were powered by 3 to 5-horsepower electric motors. Each unloader had a single cutting arm which was slowly driven around a central pivot point suspended just above the surface of the silage.

Silage was cut loose and conveyed into the central pivot point by discs, blades, single augers or double augers mounted on the rotating arm. From the center of the silo the silage was blown out through an open silo door. On at least one make, an auxiliary blower with a one-half-horsepower motor was available for installation in the unloader discharge spout to act as a booster.

The bottom unloader also used a rotating cutting arm. A heavy chain, with the cutting hooks attached, was driven from the pivot point around the slowly moving arm. This chain cut



A single auger type surface silo unloader showing suspension cable, right; drive wheel, top; enclosed auger, left center; and discharge spout, lower left.

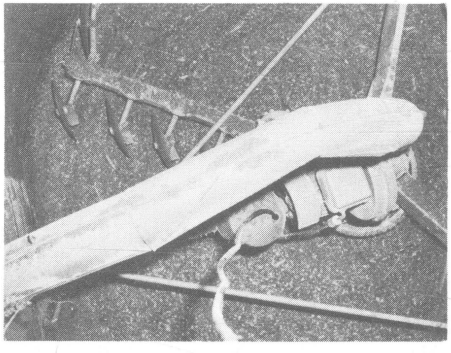
the silage loose and pulled it into the center where it dropped into a trough. A conveyor chain in the trough carried the silage out of the silo at ground level. This type of unloader was used only in a silo of the same manufacture.

Farms Average 250 Acres

Results of the questionnaires indicated that the average size farm in the state with a mechanical silo unloader was 250 acres. Farm sizes ranged from 70 to 650 acres. Each of these farms fed the equivalent of 70 head of dairy or beef cattle, with a range of from 20 to 300 head per farm.

The surface unloaders were used an average of 6½ months a year, and the bottom unloaders an average of 8 months a year. The most common silo size was 14 × 40 feet, although sizes ranged from 12 to 20 feet in diameter. Surface unloaders in 12-foot diameter silos were quite common.

In 1956, the average age of the bottom unloader was 4 years and that of the surface unloader, 2 years. Approximately 20 percent of the surface and 60 percent of the bottom unloader operators stayed with the machines while they were operating. Frozen silage was not affecting bottom unloader operations in Ohio, but it was causing some starting troubles with surface unloaders.



A surface unloader using discs on the rotating arm.

Performance Test Data

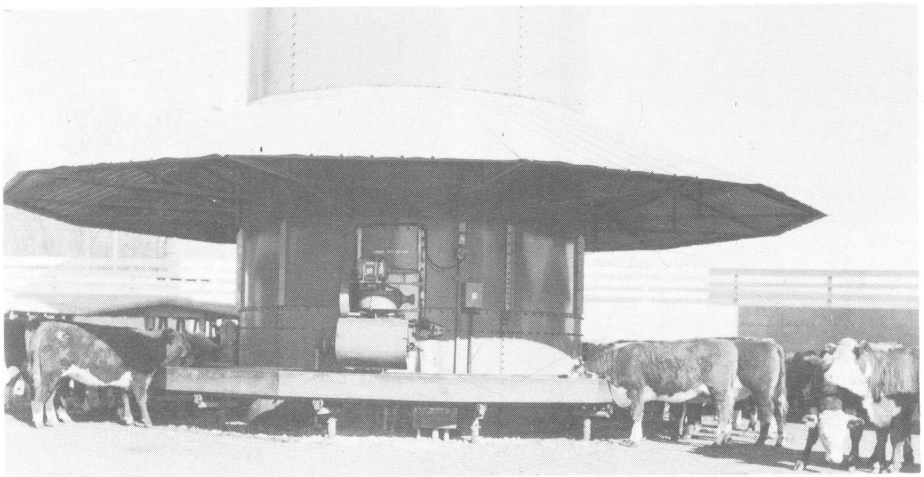
Performance tests, in which the regular farm help operated the unloaders, yielded widely varied information. In order to get an approximate unloading rate, the rates for corn and grass silage were averaged separately for bottom and for all surface unloaders tested. Table 1 lists the unloading rate and power consumption averages.

These average rates did not take into consideration the individual makes of unloaders. For surface unloaders there was a range of from 9 to 50 pounds a minute for unloading grass silage and from 28 to 110 pounds a minute for corn silage. The bottom unloaders ranged from 22 to 53 pounds a minute for grass and from 79 to 171 pounds a minute for corn silage.

In comparison, L. W. Larson (1)* of Cornell University reported a median grass unloading rate of 43 pounds a minute for surface unloaders. R. N. Van Arsdall and Thayer Cleaver (2) of the University of Illinois reported average surface unloading rates of 40 pounds a minute for grass and 60 pounds a minute for corn silage. For bottom unloaders, they reported average rates of 50 pounds a minute for grass and 120 pounds a minute for corn silage.

Most of the unloader motors were operated at less than their rated capacity; however, 3-horsepower motors

* Numbers in parentheses refer to Bibliography at end of bulletin



A bottom unloader with an electrically powered "lazy susan" type feeder.

TABLE 1. UNLOADER TEST DATA

	GRASS SILAGE					CORN SILAGE				
	Average Unloading Rate		KWH per ton	Moist %	Cut in.	Average Unloading Rate		KWH per ton	Moist %	Cut in.
	lb/min	ton/hr				lb/min	ton/hr			
Surface Unloading	33	1.0	4.3	71	7/8	53	1.6	2.5	67	5/8
Bottom Unloading	36	1.1	4.0	62	7/8	118	3.5	1.2	70	3/4

on 2 unloaders were heavily overloaded.

The human work rate for hand forking of both corn and grass silage was determined on 4 different men. For corn silage their average work rate was 91 pounds a minute, and for grass it was 83 pounds. Van Arsdall and Cleaver (2) gave manual silage unloading rates of 190 pounds a minute for corn and 130 pounds a minute for grass. The great differences were probably due to the fact that the 4 men tested in Ohio were told to work at a rate they could maintain for a long period of time. Undoubtedly the rate reported by the Illinois men would be reached by a farm worker in a hurry. Silo diameter and quantity of silage to be moved would also affect hand-forking rates.

Costs Per Ton

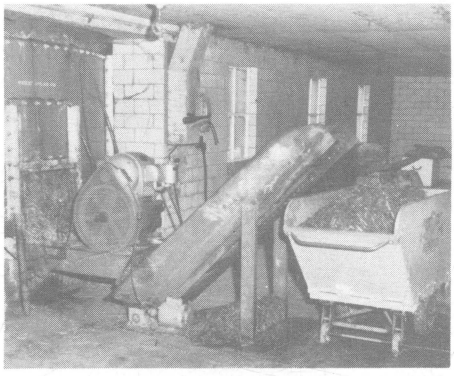
Table 2 gives estimated costs per ton for unloading various amounts of silage annually. In setting up the table, costs comparable to those for a forage blower (3) were assumed for surface unloaders. In both general types an average replacement cost for a 14-foot model with a 3-horsepower motor was used ($1100 for a surface unloader and $1600 for a bottom unloader). A large part of the higher repair cost of the bottom unloader was due to the replacement of cutting chains.

Costs for electricity at 2 cents per KWH were included in the table. For surface unloaders these averaged 8.6 cents per ton for grass and 5 cents per ton for corn silage. Electric power costs for bottom unloaders averaged 8 cents a ton for grass and 2.4 cents a ton for corn silage.

The range of power costs for all unloaders tested was from 2 to 19 cents a ton. Average unloading rates determined from the field tests were also used in preparing the table.

Surface unloaders required the least attention during operation. The bottom unloaders required almost constant attention while unloading grass silage. The operator frequently had to control the advance of the cutting arm by manual means or by reversing the drive motor. Corn silage caused little trouble for either type machine.

Unloading rates were higher for the bottom unloaders. Blower capacity appeared to limit the unloading rate of surface machines. An advantage of the bottom unloader was that it eliminated climbing; the operator of the surface unloaders had to climb the silo, every door or two, to lower the discharge spout. Surface unloaders are more accessible for repair, and if they become inoperative, feeding could continue by hand forking.



A surface unloader with elevator and feed cart.

Both Types Movable

Both general types of unloaders could be moved to other silos of the same diameter. This job requires about a half day for 2 or 3 men. In one instance, a track was constructed over 3 open silos for transferring a surface unloader without a partial disassembly.

Bottom unloaders were removed from the silo prior to filling. Surface unloaders generally were left in closed silos the year around. They were raised to the top of the silo before it was filled. With the unloader in the raised position 1 or 2 doors of the silo capacity cannot be used.

A general conclusion of the study is that in many cases the present unloaders have little advantage from a time saving standpoint. They will not, as yet, handle silage under all conditions without giving trouble. However, they do eliminate much climbing and hard labor.

TABLE 2. UNLOADER OPERATING COSTS PER TON SILAGE MOVED

	Silage Type	Years until obsolete	Hours to wear out	Total repair cost in % new cost	Cost per ton to unload various annual tonnages					
					100 T	140 T	200 T	300 T	400 T	500 T
Bottom Unloaders	Grass	12	2000	50		$1.76	1.44	1.36	1.31	1.29
	Corn	12	2000	50		1.44	1.05	.74	.59	.50
Surface Unloaders	Grass	12	2000	25	$1.55	1.18	.99	.92	.89	.87
	Corn	12	2000	25	1.46	1.08	.80	.62	.58	.56

The above costs, broken down into cost per day per head of dairy or beef cattle, are shown in Table 3.

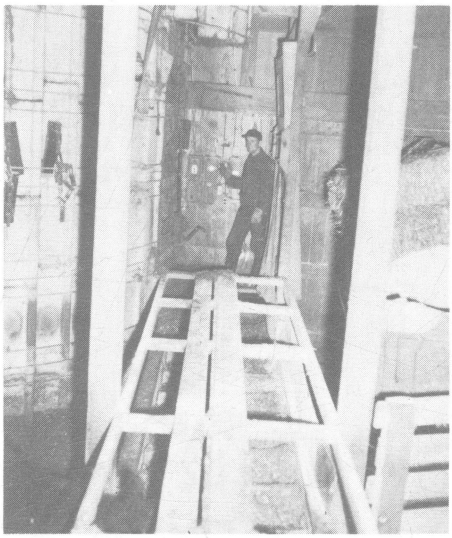
TABLE 3. DAILY UNLOADING COSTS PER HEAD RECEIVING 30 POUNDS SILAGE DAILY

	Silage Type	Cost in cents per head for various annual tonnages handled					
		100 T	140 T	200 T	300 T	400 T	500 T
Bottom Unloaders	Grass		2.6¢	2.2¢	2.0¢	2.0¢	1.9¢
	Corn		2.2	1.6	1.1	.9	.8
Surface Unloaders	Grass	2.3¢	1.8	1.5	1.4	1.3	1.3
	Corn	2.2	1.6	1.2	.9	.9	.8

Recommendations

BEFORE YOU BUY ANY UNLOADER:

1. Personally observe several up-to-date models operating in both grass and corn silage. Unloading rate is not so important, if the machine doesn't require an operator at all times.
2. Don't get too small a motor on an unloader. A 3-horsepower motor is normally used on 12 and 14-foot unloaders; however, for tough grass silage a 5-horsepower motor is often advantageous.
3. Check with your power company's rural representative to find out if wiring changes are necessary and their cost.
4. If a surface unloader is purchased, have the suspension cable located so it isn't in the middle of your back when you climb the silo.



A mechanized silage feeding arrangement combining a surface silo unloader with automatic feed bunk.

BIBLIOGRAPHY

1. Larson, L. W., Mechanical Silo Unloaders, 1954 Progress Report, The New York Farm Electrification Council.
2. Van Arsdall, R. N. and Cleaver, Thayer, Handling Silage and Concentrates For Beef Cattle in Drylot, Illinois Agricultural Extension Circular 714, University of Illinois 1954.
3. Richey, C. B., Crop Machines Use III, Agricultural Engineers Yearbook 1956, American Society of Agricultural Engineers, St. Joseph, Michigan.

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